DOCUMENT RESUME

ED 044 704 AL 002 685

AUTHOR Hanauer, S. L.
TITLE Computer-Assisted Instruction in the Pronunciation of Foreign Languages.
INSTITUTION Tokyo Univ. (Japan). Research Inst. on Logopedics and Phoniatrics.
PUB DATE 70
NOTE 7p.
JOURNAL CIT Annual Bulletin (Research Institute of Logopedics and Phoniatrics); n4 p103-9 1970

EDRS PRICE EDRS Price MF-$0.25 HC-$0.45
DESCRIPTORS *Algorithms, *Computer Assisted Instruction, Computer Programs, English (Second Language), *Language Instruction, *Language Tests, Learning Difficulties, Listening Comprehension, Programed Instruction, *Pronunciation Instruction, Syllables

ABSTRACT

This report describes the algorithm and materials developed at the Research Institute of Logopedics and Phoniatrics (University of Tokyo) for use in testing the abilities of Japanese students in the pronunciation and hearing of English monosyllabic words. The report begins with a description of the method employed for selecting the words to be used in the test and of isolating the word features used to rank the difficulty of words for speakers of Japanese. This is followed by a description of the transformation of the word data into a form suitable for the actual tests. In these tests the student is presented words one by one through a loudspeaker and asked to repeat them as best he can. These responses are judged by a native speaker of American English with no special training, who compares the student's performance with the recorded standard and then determines the next step in the program. The final section of the report describes, with the aid of a flowchart, the algorithm that has been programmed and how it is expected to be operated. See related document AL 002 686. (FWB)

ED 044704

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

COMPUTER-ASSISTED INSTRUCTION IN THE PRONUNCIATION OF FOREIGN LANGUAGES*

S. L. Hanauer**

A computer program for testing students' abilities in the pronunciation and hearing of a (foreign) language has been developed. In this report, the algorithm and material prepared for use in tests on English monosyllabic words will be described.

Fifteen stressed vowel phonemes were considered as the syllable nuclei (V), in combination with 64 consonants or consonant clusters (C_i) found in syllable-final position. Each syllable is thus of the form C_i V C_f, C_i or C_f may be null.

Each syllable is thus of the form C_i V C_f, C_i or C_f may be null.

Using Kenyon and Knott's A Pronouncing Dictionary of American English as our primary reference source, we compiled a special-purpose dictionary consisting of all the monosyllables of English, cross referenced by C_i and C_f. While the number of possible combinations of C_i, V and C_f is of the order of 200,000, not more than about 5% are actual words of the language.

From this special-purpose dictionary, we prepared the list of test items. For each C_i + V--- combination, we selected, where possible, two examples, and similarly for each --- V + C_f combination. Whenever there was a choice, we tried to select words that are more common in normal conversation. In a few instances, bisyllabic words were included, in order to have examples of the syllables that are not found as monosyllabic words. In these cases, we

---

* The work was conducted in Tokyo during the period October 1968 - March 1969.

** Present address: Bell Telephone Laboratories, Inc., Murray Hill, New Jersey 07974, U. S. A.

AL 002 685

are concerned only with the stress-bearing syllables. At present, the data consists of 2414 words; this figure can be readily increased if experience dictates the necessity thereof.

The list of 263 word features, viz. the syllabic nuclei V or the consonant clusters C_i or C_f, were subjectively ranked into six levels according to their difficulty for Japanese speakers by an experienced teacher of English and numbered in ascending order of difficulty from 1 to 6. Using these values for the word feature levels, we assigned a word level value to each word in the data simply by ordering the word feature level values from left to right in descending order. We assume that the higher the 2 or 3 digit number for a given word, the more difficult it would be on the average for Japanese students to mimic correctly. In doing so, we assume that the most difficult word feature in a word comes close to determining the overall difficulty of the word.

The list of test words is arranged so that the word-level values increase monotonically. Words having identical word level values were randomized in order to avoid fatigue and boredom on the part of the student. Thus, having appropriately ordered the data, it is always possible to move ahead through the data to find the next item, and never necessary to go back to previous material. This makes possible a very simple search procedure which is appropriate for the preparation of the test word list on tape.

While the test words are always presented to the student in the order in which they are arranged on the tape, each student receives only a subset of the total data, the decision about which data item is to be presented being made by the computer on the basis of the student's past performance, as indicated by the responses of the operator. As will be discussed in more detail later, the program will skip over data items that are judged to be already mastered by the student, and items that seem to be too difficult for the student at present, without further auxiliary practice. Such occurrences may arise from discrepancies between our assumptions of relative word feature difficulties and the abilities of particular students. If many students consistently found the same test word difficult, it would indicate that the phonological form was more difficult than we had assumed, namely, that our

ordering assumptions were wrong. This represents one of the occasions where defects in our system are readily pointed out for semi-automatic improvements.

One of our present plans is to incorporate, at some time in the future, a fourth word feature, I, in addition to C_i, V, and C_f, to account for interactions between the other three that may compound the difficulty for the Japanese speaker. While this may necessitate a reordering of some of our data, it follows in the same spirit that we are working with at present.

The next step was to transform the word data into a form suitable for the actual test, where the student is supposed to repeat the word presented to him as a reproduction of a prerecorded utterance.* The available equipment was a basic configuration PDP-9 digital computer with 8192 words of memory and a paper-tape reader/punch, coupled to a software-controlled TEAC tape recorder designed by Dr. Haruhisa Ishida. This tape recorder is a hybrid device that operates at a low speed with analog audio material recorded on one track of a standard 1/2" computer tape, or at a high speed with digital information recorded on the remaining tracks. A native speaker of American English made an analog recording of our test material in a sound treated room. On the hybrid tape, along with the speech signal, was recorded digital information giving for each word its orthographic spelling, its phonemic spelling in a special-purpose alphabet, and a special numerical key uniquely identifying each item.

The system must operate in conjunction with a human operator who is required to be a native speaker of English, but need have no further qualifications. This operator will sit at a console and will compare the student's performance with the recorded standard, and will type back to the computer his judgment from a repertoire of four possible responses: he may consider the student's performance satisfactory or unsatisfactory, he may request a repetition of the current item, or he may request that the current test-training

---

* D. Smith, et al., "The Pronunciation - hearing test using a Hybrid Magnetic Tape System," Annual Bulletin (Research Institute of Logopedics and Phoniatrics, University of Tokyo) No. 4,111-114(1970).

session be concluded, in which case the system saves the student's current status for the next session, so that he can start wherever he left off.

It remains to describe the algorithm that has been programmed, which represents the heart of the system, how we expect it to operate, and some ideas for the future. What follows is a detailed explanation of the flowchart in Fig. 1.

A test-training session begins by reading into the computer the (present) student's current status, and advancing to the appropriate position on the hybrid tape. Presently, we are allowing five different possible status entries for each word feature. They all start with status code zero, which means that this word feature has never been presented to this student. Code 1 means the student has been able to reproduce the word feature successfully at least once in a word that was pronounced entirely correctly. Code 2 means the word feature is in the major level currently being worked on but not yet mastered. Code minus 2 means the student has failed to pronounce a word containing this word feature correctly, where all the other word features are those he has mastered. And finally, code minus 1 means that the word feature was presented to the student but was not yet judged to have been mastered by the time the end of its major level was reached.

Having read in the current item, we check to see whether we have reached the end of a major level. If yes, we update the status vector. Then we check whether the current item is to be presented. If all the word features of the current word have already been mastered, we will skip it. Similarly, if one or more of the word features have proved hopelessly difficult for the student, that is if they have status code minus one or minus two, we also will skip it. If the current word passes the test and is acceptable, however, we type out the digital information on the console for the operator and present an audio output from the hybrid tape to the student. In the present system, we assume that the student will be required to repeat what he hears. An alternative idea might be a recognition test, where the student would tell the operator what he thought he heard. The operator then rates the student's response as satisfactory or unsatisfactory. As soon as the operator's response is typed in on the console, the program takes appropriate action. If unsatis-

factory, it checks whether we have reached a "conclusively hopeless" situation. If the response is satisfactory, however, we change the status vector appropriately and then check to see whether the student has mastered all the word features associated with the major level grouping currently being worked on. If yes, we advance to the beginning of the next major level. And, in all these possible branches, we conclude finally by again fetching the next item from the hybrid tape. When the operator decides to conclude the current session by typing the appropriate response on the console, the computer writes out the student's status vector to be used in initializing the system at the beginning of that student's next session.

Furthermore, the console print-out provides a useful record of the student's progress. It lists each word actually presented to the student, followed by the operator's response judging the student's performance. In addition, whenever the end of a major level grouping is reached with some of the word features in that level having a status code other than one, there will be a console print-out of those word features in that level that were "conclusively poor" (status code minus two), and those that were not presented al all.

This teaching system, while seemingly operating on a very simple algorithm, seems to us to be quite effective for the type of material we are planning to use. However, it will not be possible to make an objective evaluation until we have been able to carry out an extensive number of tests with actual subjects and then evaluate the results.

References

1) C. C. Fries, Teaching and Learning English as a Foreign Language, Ann Arbor, Michigan, University of Michigan Press, 1945.

2) J. S. Kenyon, and T. A. Knott, A Pronouncing Dictionary of American English, Springfield, Massachusetts, G. and C. Merriam Company, 1953.

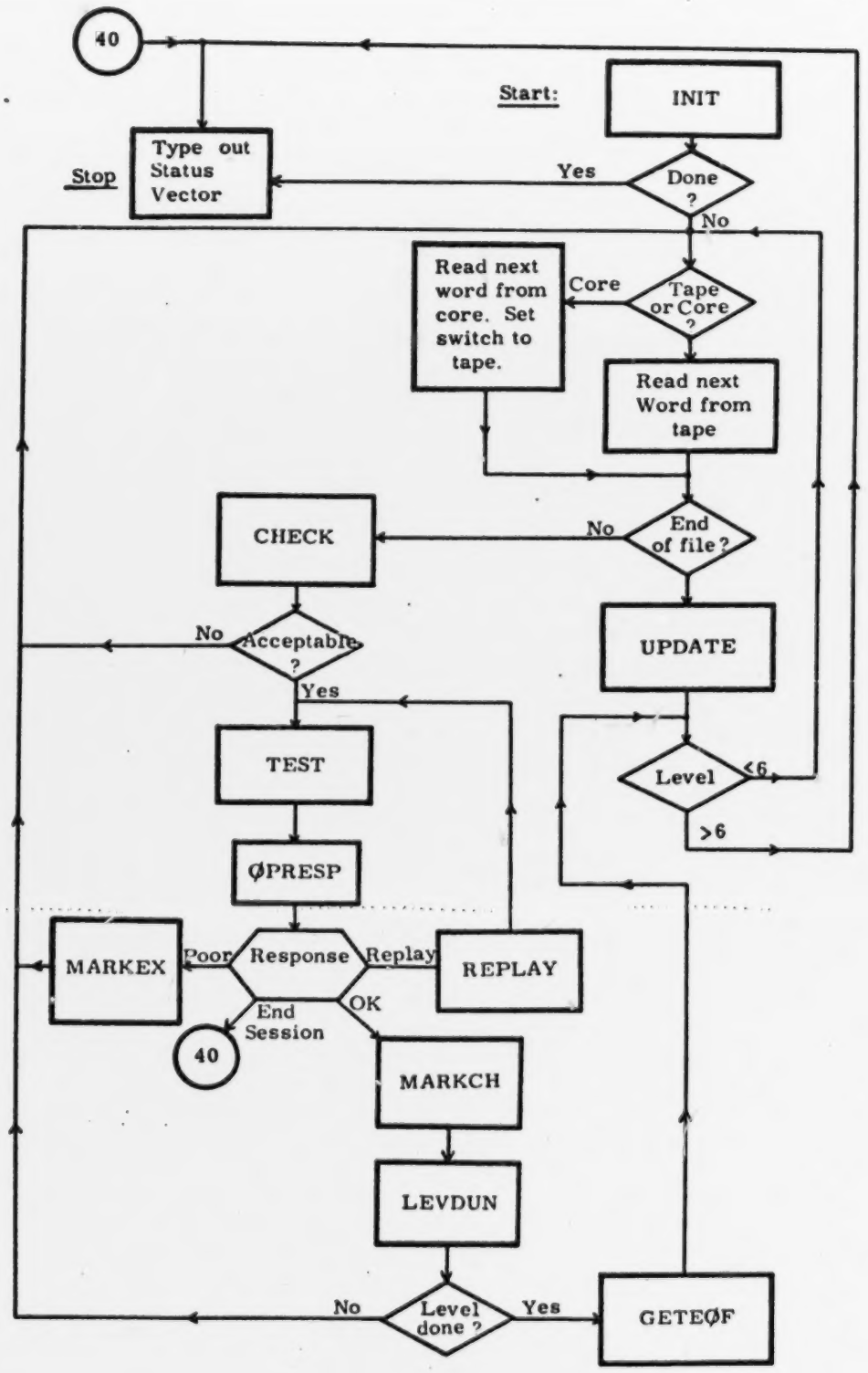

Figure 1. Notes on Flowchart

FIGURE CAPTION

Figure 1 - Notes on Flowchart

INIT

1. Read in status vector.
2. Advance to appropriate position on hybrid tape.
3. Set level counter.
4. Set switch to tape.
5. Determine whether done.

UPDATE

1. Type out results.
2. Update status vector.
3. Increment level counter.

CHECK

1. Word just read is not acceptable if all word features are O. K.
2. Nor is it acceptable if at least one word feature is bad.
3. Determine whether acceptable.

TEST

1. Type out current word on console.
2. Play back audio recording.
3. Read next word from tape and set switch to core.

ØPRESP

Operator's response to be typed in from console.

MARKEX

Determine and mark those word features that are conclusively bad.

REPLAY

Move hybrid tape back one wordl

MARKCH

Update status vector with "check marks" for O. K.

LEVDUN

Determine whether all word features of the current level are O. K.

GETEØF

1. Advance to end of current level on hybrid tape.
2. Increment level counter by one.
3. Set switch to tape.